

## WHAT IS CLAIMED IS:

1. A method for migrating a process between devices, the method comprising:

5       executing the process within a first device;  
      storing a first state of the process executing within the first device to a persistent  
store;  
      expiring one or more leases to services for the process on the first device;  
      sending the first state of the process from the persistent store to a second device;  
10       receiving the first state of the process on the second device;  
      reconstituting the first state of the process on the second device;  
      establishing the one or more leases to services for the process on the second  
device; and  
      resuming the process execution on the second device.

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2. The method of claim 1, further comprising:

      storing one or more previous states of the process executing within the first device  
to the persistent store prior to said sending the stored state of the process to the second  
device, wherein the previous states include the first state;

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      stopping the process execution on the second device;  
      selecting one of the one or more previous states of the process executing within  
the first device from the persistent store;

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and

      resuming the process execution on the first device.

3. The method of claim 1,

wherein the first state of the process comprises:

a heap for the process, wherein the heap comprises code and data for the process executing within the first device.

4. The method of claim 1,

5 wherein the first state of the process comprises:

data describing the one or more leases to services for the process on the first device, wherein the data describing the one or more leases is used in said establishing the one or more leases to services for the process on the second device.

10 5. The method of claim 1,

wherein the one or more leases to services include one or more leases to remote services, wherein the remote services are services provided on devices other than the device within which the process is currently executing.

15 6. The method of claim 1,

wherein the one or more leases to services include one or more leases to local services, wherein the local services are services provided on the device within which the process is currently executing.

20 7. The method of claim 1,

wherein the one or more leases to services include one or more leases to system services, wherein a system service comprises system code for accessing a resource external to the process, wherein the system code is provided on the device within which the process is currently executing.

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8. The method of claim 1,

wherein the first state of the process comprises:

a stored execution state of the first device;

wherein, in said reconstituting the first state of the process on the second device, a current execution state of the second device is reconstituted to the stored execution state of the first device.

5           9.       The method of claim 1,  
              wherein said reconstituting the first state of the process on the second device  
              comprises:

                  recalculating one or more transient variables for the process.

10           10.       The method of claim 1,  
              wherein the persistent store comprises one or more persistent heaps for one or  
              more processes; and

              wherein said storing the first state of the process on the first device to the  
              persistent store comprises:

15                   storing the first state of the process on the first device to a first persistent  
              heap for the process in the persistent store.

              11.       The method of claim 10,  
              wherein said sending the first state of the process from the persistent store to the  
20       second device comprises:

                  sending the first state of the process from the first persistent heap to the  
              second device.

              12.       The method of claim 10,  
25       wherein said sending the first state of the process from the persistent store to the  
      second device comprises:

                  sending a copy of the first persistent heap to the second device;

              wherein said receiving the first state of the process on the second device  
      comprises:

receiving the copy of the first persistent heap on the second device  
and wherein said reconstituting the first state of the process on the second device  
comprises:

creating a second persistent heap for the process on the second device  
5 from the received copy of the first persistent heap.

13. The method of claim 1,  
wherein the first device comprises a first in-memory heap for caching pages for  
use by the process, wherein the pages comprise code and data for the process;  
10 wherein the persistent store comprises a first virtual heap for storing pages flushed  
from the first in-memory heap;  
wherein said storing the first state of the process on the first device to the  
persistent store comprises:  
storing one or more pages from the first in-memory heap to the first virtual  
15 heap in the persistent store;  
wherein said sending the first state of the process from the persistent store to the  
second device comprises:  
sending a copy of the first virtual heap from the persistent store to the  
second device.

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14. The method of claim 13,  
wherein said reconstituting the first state of the process on the second device  
comprises:  
establishing on the second device a second in-memory heap for caching  
25 pages for use by the process; and  
copying the one or more pages stored from the first in-memory heap to the  
first virtual heap from the received copy of the first virtual heap to the second in-memory  
heap.

15. The method of claim 1,

wherein said storing the first state of the process on the first device to the persistent store, said sending the first state of the process from the persistent store to the second device and said receiving the first state of the process on the second device are performed as elements of an atomic transaction;

the method further comprising:

committing the atomic transaction on the first device and the second device if all the elements of the atomic transaction complete successfully, wherein committing the atomic transaction comprises accepting changes to data made by the elements of the atomic transaction; and

rolling back the atomic transaction if one or more of the elements of the atomic transaction fail, wherein rolling back the atomic transaction comprises restoring the data modified by the elements of the transaction to a previous state of the data prior to the start of the atomic transaction.

16. The method of claim 1,

wherein the process is executing within a first virtual machine on the first device; and

wherein said resuming the process execution on the second device comprises:

resuming the process execution on a second virtual machine on the second device.

17. The method of claim 16,

wherein the first virtual machine and the second virtual machine are Java virtual machines.

18. The method of claim 1,

wherein the persistent store is on a server external to the first device and the second device; and

wherein the first device and the second device are coupled to the server via the Internet.

19. The method of claim 1,  
5 wherein the first device and the second device each comprise a network service connection system configured to access services by establishing leases to the services; and

wherein the one or more leases are expired on the first device and established on the second device using the network service connection system on the devices.

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20. The method of claim 1,  
wherein the first device and the second device each comprise a compact network service connection system configured to execute on mobile computing devices to access services by establishing leases to the services; and

15 wherein the one or more leases are expired on the first device and established on the second device using the compact network service connection system on the devices.

21. The method of claim 1,  
wherein the first device and the second device are coupled via the Internet so that  
20 the process is migrated from the first device to the second device over the Internet.

22. The method of claim 1,  
wherein the first device and the second device are network client devices.

23. The method of claim 1,  
25 wherein at least one of the first device and the second device is a mobile computing device.

24. The method of claim 1,

wherein the process is a Java process.

- 5           25.     A system for migrating a process between devices, the system comprising:  
a first device configured to execute the process;  
a memory coupled to the first device, wherein the memory comprises a persistent  
store; and  
a second device;  
wherein the system is configured to:
- 10                 store one or more states of the process execution on the first device in the  
persistent store;  
                  send a first state of the process from the persistent store to the second  
device;  
                  receive on the second device the sent first state of the process from the  
15     first device;  
                  reconstitute the received first state of the process on the second device;  
                  establish one or more leases to services for the process on the second  
device; and  
                  resume the process execution on the second device.
- 20           26.     The system of claim 25,  
wherein the system is further configured to:  
                  stop the process execution on the second device;  
                  select one of the one or more states of the process executing within the  
25     first device from the persistent store;  
                  reconstitute the selected previous state of the process on the first device;  
                  establish the one or more leases to services for the process on the first  
device; and  
                  resume the process execution on the first device.

27. The system of claim 25,  
wherein the first state of the process comprises:

5 a heap for the process, wherein the heap comprises code and data for the  
process executing within the first device.

28. The system of claim 25,  
wherein the first state of the process comprises:

10 data describing the one or more leases to services for the process on the  
first device, wherein the data describing the one or more leases is used in said  
establishing the one or more leases to services for the process on the second device.

29. The system of claim 25,  
wherein the one or more leases to services include one or more leases to remote  
15 services, wherein the remote services are services provided on devices other than the  
device within which the process is currently executing.

30. The system of claim 25,  
wherein the one or more leases to services include one or more leases to local  
20 services, wherein the local services are services provided on the device within which the  
process is currently executing.

31. The system of claim 25,  
wherein the one or more leases to services include one or more leases to  
25 system services, wherein a system service comprises system code for accessing a resource  
external to the process, wherein the system code is provided on the device within which  
the process is currently executing.

32. The system of claim 25,



wherein the first state of the process comprises:

a stored execution state of the first device;

wherein, in said reconstituting the first state of the process on the second device,  
the system is further configured to:

5                   reconstitute a current execution state of the second device to the stored  
execution state of the first device.

33.    The system of claim 25,

wherein, in said reconstituting the first state of the process, the system is further  
10   configured to:

recalculate one or more transient variables for the process.

34.    The system of claim 25,

wherein the persistent store comprises one or more persistent heaps for the  
15   process; and

wherein the system is further configured to:

store the first state of the process execution on the first device to a first  
persistent heap for the process in the persistent store.

20       35.    The system of claim 34,

wherein, in said sending the first state of the process from the persistent store to  
the second device, the system is further configured to:

send the first state of the process from the first persistent heap to the  
second device.

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36.    The system of claim 34,

wherein, in said sending the first state of the process from the persistent store to  
the second device, the system is further configured to:

send a copy of the first persistent heap to the second device;

wherein, in said receiving the first state of the process on the second device, the system is further configured to:

receive the copy of the first persistent heap on the second device

and wherein, in said reconstituting the first state of the process on the second device, the system is further configured to:

create a second persistent heap for the process on the second device from the received copy of the first persistent heap.

37. The system of claim 25,

wherein the first device comprises a first in-memory heap for caching pages for use by the process, wherein the pages comprise code and data for the process;

wherein the persistent store comprises a first virtual heap for storing pages flushed from the first in-memory heap;

wherein, in said storing the first state of the process on the first device to the persistent store, the system is further configured to:

store one or more pages from the first in-memory heap to the persistent store; and

wherein, in said sending the first state of the process from the persistent store to the second device, the system is further configured to:

send a copy of the first virtual heap from the persistent store to the second device.

38. The system of claim 37,

wherein, in said reconstituting the first state of the process on the second device, the system is further configured to:

establish on the second device a second in-memory heap for caching pages for use by the process on the second device; and

copy the one or more pages stored from the first in-memory heap to the first virtual heap from the received copy of the first virtual heap to the second in-memory heap.

39. The system of claim 25,  
wherein the first device comprises a first virtual machine executable on the first device;

5 wherein the first virtual machine is configured to execute the process; and  
wherein, in said resuming the process execution on the second device, the system is further configured to:

start execution of a second virtual machine on the second device; and  
resume the process execution on the second virtual machine on the second  
10 device.

40. The system of claim 39,  
wherein the first virtual machine and the second virtual machine are Java virtual machines.

15 41. The system of claim 25,  
wherein the first device and the second device are coupled via the Internet so that the process is migrated from the first device to the second device over the Internet.

20 42. The system of claim 25,  
wherein the first device and the second device are network client devices.

43. The system of claim 25,  
wherein at least one of the first device and the second device is a mobile  
25 computing device..

44. The system of claim 25, further comprising:  
a server coupled to the first device and the second device via the Internet, wherein the server comprises the persistent store.

45. The system of claim 25,  
wherein the process is a Java process.

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46. A carrier medium comprising program instructions, wherein the program instructions are computer-executable to implement:

storing a first state of a process executing within a first device to a persistent store;

10 expiring one or more leases to services for the process on the first device;

sending the first state of the process from the persistent store to a second device;

receiving the first state of the process on the second device;

reconstituting the first state of the process on the second device;

15 establishing the one or more leases to services for the process on the second device; and

resuming the process execution on the second device.

47. The carrier medium of claim 46, wherein the program instructions are further computer-executable to implement:

20 storing one or more previous states of the process executing within the first device to the persistent store prior to said sending the stored state of the process to the second device, wherein the previous states include the first state;

stopping the process execution on the second device;

25 selecting one of the one or more previous states of the process executing within the first device from the persistent store;

reconstituting the selected previous state of the process on the first device;

establishing the one or more leases to services for the process on the first device;

and

resuming the process execution on the first device.

48. The carrier medium of claim 46,  
wherein the first state of the process comprises:

5 a heap for the process, wherein the heap comprises code and data for the  
process executing within the first device.

49. The carrier medium of claim 46,  
wherein the first state of the process comprises:

10 data describing the one or more leases to services for the process on the  
first device, wherein the data describing the one or more leases is used in said  
establishing the one or more leases to services for the process on the second device.

50. The carrier medium of claim 46,  
wherein the one or more leases to services include one or more leases to remote  
15 services, wherein the remote services are services provided on devices other than the  
device within which the process is currently executing.

51. The carrier medium of claim 46,  
wherein the one or more leases to services include one or more leases to local  
20 services, wherein the local services are services provided on the device within which the  
process is currently executing.

52. The carrier medium of claim 46,  
wherein the one or more leases to services include one or more leases to system  
25 services, wherein a system service comprises system code for accessing a resource  
external to the process, wherein the system code is provided on the device within which  
the process is currently executing.

53. The carrier medium of claim 46,

wherein the first state of the process comprises:

a stored execution state of the first device;

wherein, in said reconstituting the first state of the process on the second device, the program instructions are further computer-executable to implement:

5 reconstituting a current execution state of the second device to the stored execution state of the first device.

54. The carrier medium of claim 46,

wherein the first device comprises a first in-memory heap for caching pages for  
10 use by the process, wherein the pages comprise code and data for the process;

wherein the persistent store comprises a first virtual heap for storing pages flushed from the first in-memory heap;

wherein, in said storing the first state of the process on the first device to the persistent store, the program instructions are further computer-executable to implement:

15 storing one or more pages from the first in-memory heap to the first virtual heap in the persistent store; and

wherein, in said sending the first state of the process from the persistent store to the second device, the program instructions are further computer-executable to implement:

20 sending a copy of the first virtual heap from the persistent store to the second device.

55. The carrier medium of claim 54,

wherein, in said reconstituting the first state of the process on the second device,  
25 the program instructions are further computer-executable to implement:

establishing on the second device a second in-memory heap for caching pages for use by the process; and

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